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Generic Tools and Methods for Obsolescence Control

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Summary

The increasing discrepancy between the life cycles of professional electronics equipment and the life cycles of the components (which are largely intended for volume markets) means that professional electronics manufacturers must implement methods, processes and tools to give their customers long-term availability guarantees for their products despite obsolescence problems in the components.

Although this effort must be made at the level of each unit and adapted to the type of product, the customers' needs and internal organisation, the existence of common methodological tools and principles can significantly help each unit set up the appropriate procedure for their particular case.

This paper gives an overview of the methods and tools set up within the Thomson-CSF group to support the units in this procedure.

These can be split into four levels, which correspond to increasing maturity of the obsolescence risk control.

Level 1   :   curative level (during production and use phases).

Level 2   :   downstream preventive level (also during production and use phases).

Level 3   :   upstream preventive level (during development phase).

Level 4   :   upstream preventive level (during design phase).

Finally, it asserts that controlling obsolescence and being able to guarantee the long-term availability of equipment is now a major part of the professional electronics manufacturer's job, and is an increasingly important factor in meeting customers' needs.

1.   An irreversible change requires a response

The problem of obsolescence suddenly took on significant proportions during 1993 and 1994. In reality, it is a much older phenomenon (it has always existed right from the origin of the components). However, up to 1993-1994, the professional electronics world (manufacturers and customers) let itself think that it was a minor problem that could be solved easily in production centres by replacing the obsolescent component by another functionally equivalent component.

Three events, the effects of which came together in 1993-1994, significantly increased the scale of the phenomenon and the seriousness of its consequences, and gave rise to a radical questioning of the processing methods previously used. These three events were:

1)   the gradual loss of influence, on the semiconductors market, of long-cycle professional electronics industries (aerospace, space, defence, industrial control) in favour of short-cycle consumer industries (computer, telecommunications, multimedia). Below the crucial 10% threshold, the long-cycle industries were no longer an attractive outlet for the semiconductors industry, which was seeing an explosion in its market (+20% per year);

2)   the DoD's announcement of its intention to promote the use of dual-use technologies (see [1]) wherever possible and, consequently, in the field of components, to target its aid on absolutely vital components in defence equipment. Several semiconductor manufacturers then decided to stop producing MIL-883 components. As regards quality, this move was judicious as the absence of these components today does not prevent the design of equipment that is just as reliable as before. However, as regards long-term availability, it means that manufacturers have to work with components that do not have the same durability as those that were formerly intended for the long-cycle industries;

3)   the considerable developments in technology that meant that, for the first time in 1993-1994, obsolescence affected components that were:

- difficult to replace (no upward compatibility),
- difficult to emulate with an ASIC (as they were already very complex),
- and had an impact on numerous software lines (i.e.: microprocessors).

These three events are permanent, not to mention irreversible.

The professional electronics industry could therefore no longer continue to treat the obsolescence phenomenon as a minor problem. It had to organise itself to take the appropriate steps to reduce the consequences to a minimum (as no-one has yet found a miracle solution to end the phenomenon of obsolescence or completely eliminate its consequences).

2. The analysis of the situation carried out at Thomson-CSF

2.1 Working groups

By 1995 it was clear that this change was irreversible, and to find the most appropriate response to it, the Thomson-CSF group set up two working groups with representatives from all of the units affected, for various reasons, by the problem of obsolescence.

- The first was in charge of analysing the short-term responses (mainly curative) to the problem of obsolescence.
- The second was in charge of analysing the preventive measures to be put in place over the whole life cycle of a product in order to reduce the consequences of obsolescence problems to a minimum.

These groups operated during 1995 and 1996. Their recommendations were implemented very quickly and make up the anti-obsolescence system currently used within Thomson-CSF. These groups now meet two to four times a year to re-analyse the situation and the appropriateness and smooth operation of the system.

The existence of these groups allowed for plentiful exchanges between the units represented, both on the problems encountered and on the best practice implemented to remedy them. Their main conclusions are set out below:

2.2 The problem must be dealt with by the manufacturer

The first element that appeared in the working groups was the diversity of customers' attitudes to the obsolescence problem.

The Thomson-CSF group (and therefore the units represented in the working groups) operates on three main professional electronics markets:

- the defence sector,
- the aerospace sector,
- the Business to Business or B to B sector.

This position allowed it to note that customers behave in radically different ways when faced with obsolescence and that this behaviour causes equally antagonistic reactions from the manufacturers.

On one hand, customers in the civil aviation sector (aircraft manufacturers, airlines or airports) and B to B sector customers feel that it is up to the manufacturer to find solutions to the obsolescence problem and wish to distance themselves from it as far as possible.

On the other hand, in the defence sector, several MoDs in large countries (particularly, but not only, the US DoD) wanted to find solutions to the obsolescence problem and pass them on to their manufacturers.

This second attitude is a sort of extension of the old situation when the MoDs (and especially the DoD) were major suppliers of technology in the field of components. However, in the new situation, it inevitably affects costs optimization, as sharing responsibilities between the manufacturer and the customer does not facilitate the search for an overall optimised solution to the obsolescence problem. Rather, it encourages the implementation of radical but costly solutions (strategic stocks, financing of the component manufacturer, setting up of alternative sources, etc.) when very often the problem could be solved at a lower cost within the framework of a more general approach (as several components are often simultaneously affected by obsolescence).

This attitude leads to a lack of competitiveness for the manufacturer, who has to manage two conflicting processes depending on which market it is dealing with.

Everything points towards the idea that this specific feature of the domestic defence market will gradually disappear. The defence market has already admitted, several years ago, that it could cover 90% of its requirements with components designed for other markets. It is probable that sooner or later it will also decide to delegate responsibility for controlling the risks linked to these components to the manufacturer, as other professional electronics customers do already.

For all these reasons, it was apparent that the Thomson-CSF group should equip itself with means (tools and methods) to allow it to offer all its customers, including those in the defence sector, solutions in which it would take on the obsolescence control itself. Of course, this does not exclude dialogue with the customer to inform them of the problems encountered and try to find the most appropriate responses with them. Such dialogue is even strongly encouraged (see § 4.1). Nor does it exclude working differently on some contracts, with customers who want to be more closely involved in the search for solutions to obsolescence.

There is now a wide consensus of approval for this process in France, including in the defence sector; the French MoD and the defence manufacturers are on the point of entering into an agreement at the end of which the MoD will hand over most obsolescence problem control to the manufacturers and even, more generally, most of the control of problems linked to components (selection, obsolescence, quality, reliability, resistance to environment, etc.).

This procedure falls within the same logic as that used by Thomson-CSF and the French MoD in the area of component quality. In 1988, the decision was taken to switch to commercial and industrial components to replace military components (see [2]). This began with radio equipment for the French army. Gradually, this strategy spread to all the equipment produced by Thomson-CSF in all areas (aerospace, defence, B to B), and today the Thomson-CSF group uses very few military range components or QML certified components on new designs. The group itself provides quality assurance using a very strict method of assessing component processes (see [3]). This yields a considerable saving on components costs, and also much better control of quality and reliability in severe environments (see [4]).

The only limit that must be placed on this procedure relates to components with specific defence uses. These are components necessary in the defence area (as their specific performance has a direct impact on the performance of the

defence systems) but for which the non-defence market is too small to ensure the financing of the necessary processes. A typical example is high power GaAs. For reasons that will not be elaborated on here (see [4]), it is often difficult for the manufacturer to provide this financing. Government aid may be necessary to provide the financing and prevent supply shortages that would cause insurmountable industrial problems. Again, however, the procedure must be to limit these processes to those that are strictly necessary, so that this procedure is the exception and not the rule. Moreover, this is what is recommended in Secretary Perry's Memorandum (see [1]).

2.3   The procedure must cover the whole life cycle

The second element that the working groups agreed on unanimously was the need to take obsolescence into account and to seek to provide the best responses at every stage of the life cycle.

Of course, the first question that comes to mind in a discussion about obsolescence is to find out which solutions are applied to it (i.e. once the problem has occurred).

This is an important subject, and any good anti-obsolescence system should provide a response to it. We will therefore deal with this subject in §3.1 and 4.3.

However, limiting oneself to purely curative treatment, once the problem has arisen, is certainly not the best way to approach obsolescence.

In fact, in addition to the curative approach that applies to the phases of production of the equipment and its use by the customer (including logistic support), the obsolescence problem must be analysed constantly at each stage of the life cycle with the aim of setting out the best solution at each stage, i.e. the solution that will minimise the consequences of obsolescence in future. This preventive attitude of systematic risk anticipation and searching for the best solutions applies to:

- the production and customer use phase (see §3.2 and 4.3),
- the development phase, particularly for component selection (see §3.3),
- the design phase, particularly for architecture selection (see §3.4 and 4.2),
- and even the pre-sales phase, as the establishment of sound and explicit contractual rules between the manufacturer and the customer is such a vital element to prevent any subsequent misunderstanding and confusion (see §4.1.2).

2.4   The variety of situations and appropriate responses

The third element on which everybody agreed was the great variety of situations and consequently the difficulty of transposing best practice as it is from one unit to another when the situations are too different.

As a rule, for each situation, the selection of the most suitable response must take into account:

- the customer's needs. The range of applicable solutions would therefore be very small if the customer required all its equipment to be strictly identical. The range would be larger if the customer were satisfied with functional equivalence (fit, form, function). It would be even larger if the customer looked favourably on progressive updates to the equipment in order to benefit from technological developments (enhanced performance at a lower cost);
- the quantities to be provided and the interval between the provision of these quantities; the best response will not be the same, depending on whether it is:
    - a delivery to be made within a short deadline ($\leq$ 2 years),
    - a large quantity to be delivered within a long deadline,
    - a small quantity to be delivered within a long deadline;
- the "commonality" between products. In some situations, a policy of designing from modules common to several products can allow for better optimised responses than would have been possible if each product had been considered in isolation;
- etc.

2.5   Use of common tools and principles for obsolescence control

As they were unable to define best practice applicable to everyone in all situations, the participants of the two working groups rapidly agreed unanimously on the benefit of pooling their experience and defining a set of common principles and setting up the corresponding tools.

More specifically, they came up with the following analysis:

1) a fundamental approach in obsolescence control is to tackle the problem in terms of risk control;
2) risk control can be broken down into a few simple principles (list of questions to ask oneself). These principles can be common to everyone, even if the responses to them (best practices) vary depending on the individual situation;
3) risk control requires certain tools that also gain by being common to everyone;
4) in addition to the principles (theoretical), a collection of best practice can be very useful for everyone (benchmark type approach), even if it is not always easy to transpose a given best practice from one situation to another.

This analysis allowed the groups to design a system that was common to all of the units in the group. The system has now been in operation for several years, and will be described in this paper.

However, we will only touch briefly on the best practices implemented in the units, as they are often linked to a specific context and we wish to focus on points common to everybody in this paper. Other papers (particularly [5], which illustrates the procedure recommended in §4.2.1), give a clearer idea of what these best practices might be.

2.6 The common obsolescence control system

This system is illustrated in figure 1.

As we have just seen, it is made up of:

• a (common) tools section, supplemented by the availability of expertise,

• a (common) methods section, supplemented by an organisation in charge of coordination.

It covers every stage of the life cycle; the need for this was outlined in §2.3. It can be read from top to bottom, in chronological order of the life cycle, or in the opposite direction, in increasing order of maturity, as it is true that the most mature responses are those that anticipate the problem as far upstream as possible.

We will now describe it in more detail. We will begin with the tools aspect, which is easier to approach first as it gives concrete responses to specific problems. The tool aspect will be covered in chapter 3. We will then deal with the methods aspect, which is in essence more abstract, in chapter 4.
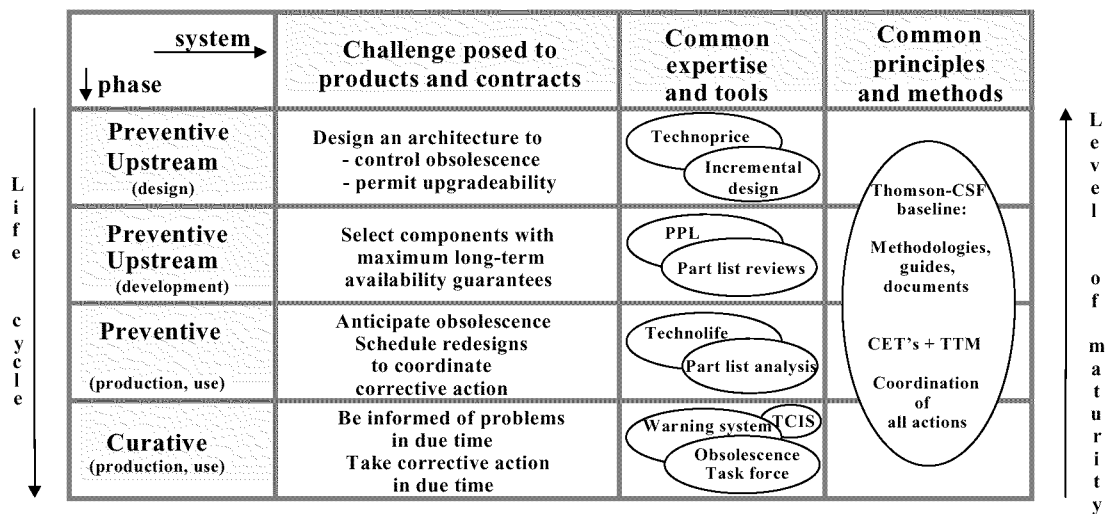
system → ↓ phase	Challenge posed to products and contracts	Common expertise and tools	Common principles and methods
Preventive Upstream (design)	Design an architecture to - control obsolescence - permit upgradeability	Technoprice / Incremental design	Thomson-CSF baseline:
Preventive Upstream (development)	Select components with maximum long-term availability guarantees	PPL / Part list reviews	Methodologies, guides, documents
Preventive (production, use)	Anticipate obsolescence Schedule redesigns to coordinate corrective action	Technolife / Part list analysis	CET's + TTM Coordination of all actions
Curative (production, use)	Be informed of problems in due time Take corrective action in due time	Warning system TCIS / Obsolescence Task force	

Figure 1 : Common obsolescence control system

3. Common obsolescence control tools in use in Thomson-CSF

Sticking to our philosophy of giving first a description of the precise responses given to the most concrete problems, we will describe the tools part of the common system in an "upstream order" through the life cycle of equipment. This will enable us to describe the means put in place to find solutions when problems are urgent, generally during the phases of production or customer use of the equipment. We will then examine what can be done in a more preventive (and more mature!) way by trying to anticipate problems, firstly during the phases of production or customer use, and then – better still – during the upstream phases of the life cycle, design and development.

3.1 The tools and expertise for curative treatment

The tools and expertise for curative treatment meet two aims:

1) to allow the units to be informed of problems in due time,

2) to allow the units to take corrective action in due time.

3.1.1 Being informed of problems in due time

Although it may initially seem surprising, the first obstacle to overcome to set up an effective curative treatment process for obsolescence is having the necessary information in due time.

From the component suppliers' point of view, the main characteristic of the professional electronics industries is that they give small orders spread over long periods. The suppliers do not therefore always automatically think of informing a "small customer" about all obsolescence, in particular when it occurs in components that the "small customer" hasn't ordered for months (sometimes years), or has never ordered before. Using sub-contractors for production only aggravates the problem as it creates yet another link in the information chain, with all the risks involved.

During 1993 to 1995, each Thomson-CSF unit had gradually set up its own obsolescence information gathering and processing department. However, this was costly and inefficient in terms of cover.

The decision was therefore taken in 1995 to give a support unit, TTM (Thomson-CSF Technologies and Methods), responsibility for collecting and processing all the obsolescence information and distributing it to all of the units in the group.

The initial principle was to ask every purchaser who was aware of an obsolescence problem to inform TTM, which would then immediately pass the information on to all of the units. In reality today, the information gathered by TTM comes mainly from relationships established with manufacturers and a systematic analysis of their web sites and of independent specialist obsolescence web sites. The purchasers now only provide additional information that, above all, highlights any deficiencies in the cover or reactivity of the system.

As shown in figure 2, the system actually goes well beyond simply distributing the information received:

First, the information gathered is processed. This work gives considerable added value in relation to the raw information, which is often:

- redundant (several suppliers announce the same measures),
- inconsistent (some obsolescence is a stoppage at the distributor, but the products still exist elsewhere),
- non-specific (a supplier announces that a family is no longer produced, without specifying an exact list of the parts affected);

Then, the components in question are matched with the Thomson-CSF component information system, which allows the units to identify them easily in their item databases. This also gives an initial list of potential replacement components.

When the file created in this way is distributed (once a fortnight), the units are asked in return to indicate which components affect them.

Thanks to this return of information, 2 additional services can be provided:

- firstly, an additional equivalents search (complete or approximate) is systematically initiated and the information obtained is systematically checked: when a component goes out of production, it is often the market that has disappeared and it is therefore useful to check that the equivalents have not also gone out of production;
- secondly, each unit also receives a list of the other units with the same problem, which is very useful for helping each other or looking for solutions together (stock, after market, substitute ASIC or PLD, etc.);

Finally, the information is archived in the Thomson-CSF Component Information System (TCIS) so that it can be found again later.

Today, this system is fully operational and every unit receives a file once a fortnight containing all the obsolescence detected over the last two weeks. The widely held opinion is that the coverage is very good.

Obsolescence warnings were given in this way for 20,000 components in 1999. The responses provided in return by the units show that, statistically, 10% of these components (2,000 per year) have an impact on at least one unit in the group.

Figure 2 : Obsolescence warning system

3.1.2 Taking corrective action in due time

The second obstacle to overcome when setting up an effective curative obsolescence treatment process is knowing how to take corrective action in due time.

Unlike the previous obstacle (gathering information), for which a central service alone can give 100% of the solution, decision making is a process that requires a great deal of internal organisation within each unit (we will deal with this subject in §4.3) and which can be made much easier by anticipation (we will deal with this subject in §3.2, 3.3 and 3.4).

However, a central service can still help significantly in finding solutions.

The Thomson-CSF group therefore decided to create an "Obsolescence Task Force" (TFO) with the task of helping the units find solutions.

In practice, the solutions can be very varied in nature:

1) searching for a strictly equivalent component,
2) searching for a more or less equivalent component,
3) creating a reserve stock,
4) buying stock available on the market,
5) sharing stocks between units,
6) negotiation with the supplier,
7) calling on after market companies,
8) producing a substitute component (ASIC or FPGA),
9) partial or total redesign of the card,
10) etc.

As we can see, some of these are purchasing solutions and others are technical solutions (or require technological expertise). They must all be decided on urgently. Finally, sharing between units is often an advantage, whether for finding solutions or implementing them, as knowledge is pooled, costs are shared, the units have greater weight in negotiations, etc.

The Obsolescence Task Force (TFO) is therefore made up of:

- a network of purchasing experts,
- a network of technical/technological experts,
- and a coordinator.

The coordinator is the single interface for all of the units whenever they need help regarding obsolescence. They can contact him at any time by email, fax or telephone. They can also visit his web site where they can find advice, warnings and in particular, the accumulation of answers to questions in an FAQ (Frequently Asked Questions) section. In many cases, due to his experience with such problems, the coordinator can answer the questions he is asked straight away. However, for new subjects he may consult one of the networks of experts. In addition, the coordinator, sometimes with the help of the networks, has the task of coordinating the research and implementation of solutions common to several units when it appears that a common solution is preferable to several separate solutions.

The purchasing network is made up of component buyers from the different units, who therefore have wide experience of concrete problems. They are both customers of the TFO when they are looking for a solution, and solution providers when another unit has asked a question via the TFO and they have the answer.

The technical network is made up of technological experts with in-depth knowledge of the components field. Most of these experts are in TTM, which has, amongst others, the task of evaluating the components and components processes for the whole of the Thomson-CSF group. These experts carry out systematic studies in the area of obsolescence on subjects such as:

- the interchangeability rules between technologies and the precautions to take,
- the extension of temperature ranges, upgrading, derating,
- the assessment through technical audits of the quality and reliability of the products offered by after market manufacturers,
- the methodological rules to follow to transfer an ASIC or FPGA design to a more recent generation,
- etc.

The units can consult the technical experts at any time on obsolescence problems, either directly or via the TFO coordinator. The results of their studies are made available to everyone on the TFO web site.

3.2   The tools and expertise to anticipate in the production or customer use phases

In §3.1.1 and 3.1.2, we mentioned what should be done every time an obsolescence warning arrived. Obviously, the problem of controlling the obsolescence risk cannot be resolved optimally using curative methods alone.

In addition to these methods, which remain vital, it is important to anticipate.

In §3.3 and 3.4 and later in chapter 4, we will discuss anticipation during the equipment design and development phases. In this paragraph, we will start by looking at what kind of anticipation can be done during the downstream production and customer use phases, that is, after the equipment is developed.

When obsolescence affects a piece of equipment, the very first reflex must be to ask whether further obsolescence is about to occur. Nothing proves that the solution (stock, upgrade, redesign, etc.) that seems best to handle obsolescence taken in isolation will remain the best solution if the fact that further obsolescence is about to occur is taken into

account in the economic analysis. For example, how much stock has been scrapped because soon afterwards, further obsolescence has meant that a module has to be completely reworked?

The difficulty is that if one waits for obsolescence to occur to carry out this analysis, it is often too late, as time is short and urgent action is required.

Again, the mature attitude is to anticipate. The part list for every piece of equipment must be reviewed regularly (every 12 months) and the following action taken:

- analyse the predicted end of life date of each component in the equipment,
- update the sales projections for the equipment,
- depending on these two analyses, update the projected redesign dates and the course of action to be taken until the next date.

To support the units in this procedure, the Thomson-CSF group decided to provide them with a tool and expertise; the tool, known as Technolife, is a database maintained and distributed by TTM that contains predicted end of life dates for a large number of components.

In addition, for components that are not in the database, the units have access to the component experts in TTM and other units (via the TFO). Furthermore, the answers given are amassed in the Technolife database and then updated every year, which allows Technolife to give excellent coverage of the components used by the Thomson-CSF units.

3.3   The tools and expertise to anticipate in the development phase

In §3.1 and 3.2 we mentioned what should be done to control the obsolescence risk during the production and use phases, that is, on equipment that has already been designed.

Taking the obsolescence problem into account on equipment in the upstream phases of the life cycle opens up many other levels of freedom.

During the development phase, and particularly when the list of components is selected, the level of freedom consists of choosing components with the best long-term availability prospects possible.

Unfortunately, although it is easy to set out this aim, it is costly to implement. Indeed, forming an opinion on the long-term availability prospects of a component requires market research, which has a cost. (It goes without saying that the manufacturer's sales pitch is generally not enough to gain an objective idea of the long-term availability prospects of the components in their catalogue!)

The route taken at Thomson-CSF to meet this aim at a reasonable cost was to try to cut the selection of components for all the units down to a very small number (see [4]). Initially (1994) when the decision was taken, the task seemed immense and almost insurmountable, as the areas in which the units worked seemed so diverse and their needs seemed so divergent. However, gradually, due to a highly reactive process in which each unit's needs, including for the most recent components, were systematically analysed and due to a better collective awareness of the risks involved in making inopportune choices, all of the units were able to agree on common choices for products being designed/developed.

Today, a very small set of components (2,500 parts, of which 500 are active) known as the Thomson-CSF components preferred parts list (PPL), allows most of the units in the group to cover approximately 80% of their needs.

From the point of view of obsolescence control, the use of the Thomson-CSF PPL is a very effective method, as it allows the following activities to be carried out for a cost shared between all of the units in the group:

1) market research so that the component with the best long-term availability prospects can be chosen, function by function.

2) regular updates of this market research in order to anticipate possible problems well before the official withdrawal announcements.

In reality, the benefits of the Thomson-CSF components PPL goes far beyond questions relating to obsolescence:

- regarding quality/resistance to environment, it allows for a similar procedure, i.e. in-depth analysis of the quality of the selected processes and monitoring changes to this quality over time. Remember that Thomson-CSF has implemented its own quality assurance policy to select the civil component processes (commercial or extended ranges) that offer sufficient guarantees to be used in extreme environments, with all the reliability necessary (see §2.2);
- regarding purchasing, it allows negotiations to be focused on a small number of components and suppliers, meaning that better conditions can be obtained (prices, deadlines, service);
- regarding the models necessary for CAD tools, the number of components to be modelled can be significantly reduced, thus reducing production costs;
- regarding exchanges of experience (technical, quality, purchasing), the fact that all of the units use the same components greatly encourages information exchanges.

In addition to the PPL tool, the units can also systematically turn to the TTM experts for part list reviews:

- for the unit, it is a way of understanding the various options possible and the associated risks,
- for TTM, it is an additional means of updating the PPL through analysing any inadequacies it may have on a specific project.

3.4   The tools and expertise to anticipate in the design phase

Approaching the obsolescence problem even further upstream, i.e. during the design phase of a piece of equipment, gives the advantage of a further level of freedom - designing an architecture that can better withstand component obsolescence.

We will not expand on this point, which is dealt with in §4.2.1. However, we will look ahead to the recommendation made in the conclusion to that paragraph: the evolution of the architecture over the whole life cycle must be analysed from the start of the project.

Unfortunately, technology evolves very rapidly (see the consequences of Moore's law in §4.2.1). It is therefore almost impossible to successfully analyse a life cycle if there is no tool that allows an overview of this technological evolution.

Such a tool has been set up within the Thomson-CSF group. This is a knowledge base known as Technoprice. Based on Moore's law and the expertise of the best components specialists in the group, it contains the forecasted evolution for the next ten years in the performance, price and functions of the components useful to the different units in the group. It is distributed to all of the units in the group.

Using the information it contains, it is possible to:

- gain a realistic idea of the performance upgrades and/or price decreases of a given architecture,
- gain a realistic idea of the performance and price of competing equipment in 5 or 10 years.

It is therefore a tool to optimise the choice of architecture in order to make the equipment competitive for as long as possible.

4.   Methodological principles for obsolescence control in use in Thomson-CSF

In chapter 3, we listed the tools and expertise that the Thomson-CSF group provides all of the units for the most effective obsolescence control possible.

Of course, tools and expertise (that is, in both cases, information), are not sufficient to deal effectively with obsolescence. In addition, and above all, organisation and methods are required.

These must be put in place in each unit.

As we pointed out in §2.2, the organisation and methods can vary considerably from one unit to another, in that they must be suited both to the rest of the unit's organisation and in particular to the type of market and type of customer the unit targets.

However, this does not mean that there is nothing to pool within a group which, like Thomson-CSF, operates with a great variety of customers and markets. Hence, the working groups mentioned in §2.1 made the following analysis:

Firstly, simply sharing organisations and methods created by other units can be very useful as it is intellectually stimulating. The Obsolescence Task Force therefore created a "best practices" section on its web site. This offers a way for units to benchmark themselves against others. Moreover, the meetings of the obsolescence representatives organised by the TFO enable these best practice exchanges to be taken further through direct, informal contact.

However, it seemed possible to go further than simply exchanging best practices.

When the different best practices are analysed, it can be seen that the basic attitude behind them is to view obsolescence as a risk and look for remedies in a risk control type procedure.

This obsolescence risk control itself involves two rules of conduct:

1) upstream of the life cycle (design and development phases), knowing how to anticipate the risk in order to make the choices that will minimise the consequences when the risk becomes reality,

2) downstream of the life cycle (production and use phases), knowing how to be reactive, i.e. being able to take the decisions that enable the consequences to be minimised when the risk becomes reality.

The choices to be made upstream of the life cycle that have an impact on obsolescence control can be broken down into:

- management choices (with the customer playing a significant role),
- technical choices.

Downstream, reactivity is above all a matter of organisation.

We will therefore look at these three points in turn in the following three paragraphs.

4.1   Controlling the obsolescence risk upstream: the role of management and the customer
4.1.1   Thinking through the life cycle

As by its very essence, obsolescence has delaying effects (even though the acceleration of replacement of components makes these effects appear earlier and earlier in the programmes), the consequences and, most importantly, the cost of obsolescence can only be minimised if one thinks through the whole life cycle, right from the start of the programme, in an LCC (Life Cycle Cost) approach. It is clear (we will return to this point in the following paragraph) that choosing architecture that allows for a minimum cost for the first years of the life of a project does not necessarily mean that it will allow for a minimum cost over the whole life cycle. To go further, not only the acquisition cost of the equipment should be taken into account, but more generally the cost of ownership as seen by the customer and including the impact of the performance aspect. However, this does not alter the conclusion, which is that to minimise the LCC, the whole of the life cycle must be analysed right from the start of the programme.

4.1.2 Clarify the rules with the customer

It is clearly the responsibility of the programme manager and/or their customer to impose this type of life cycle reasoning we have just discussed. This might seem obvious, and so it is when the manufacturer is committed to supplying given quantities on given dates at a given price. It also is when the manufacturer is committed to keeping a product in its catalogue for a given period at a given price. In the second case, when the customer has not made a clear commitment on quantities, the manufacturer will make projections and base its strategy on these projections.

However, the rules are not always this explicit, particularly for contracts made with governments (and not only in the defence sector). For various reasons, the customer may have problems making a long-term commitment on order volumes and a specific schedule. When the customer is a government, the strong impact of politics can make volume and schedule projections very difficult for the manufacturer. Sometimes (and again, often for tactical or even political reasons), the customer might prefer an offer in which the initial acquisition cost is lower (as this will allow it to launch the programme) to an offer in which the overall cost of possession is optimised.

In all cases, and even if it is not pushed by its customer, the manufacturer's course of action must be to analyse the complete life cycle of the equipment, draw up a solution that minimises the LCC and offer it, even if only as an option, to the customer. The customer is then free to give another criterion for optimisation if this criterion meets its own constraints better. At least the ambiguity will be removed.

4.1.3 Budgeting

Once the principles of optimisation over the whole life cycle have been accepted by both the manufacturer and the customer, the manufacturer must evaluate the cost of obsolescence control and put in place the corresponding budgets (which, in certain situations, requires the customer's agreement again).

Again, this is obvious, but in 1995-1996, when the analysis was carried out, many contracts were faced with the obsolescence control problem without having budgeted for it. This often prevented the correct decisions being made in due time. The working group therefore felt that it was appropriate to set out this rule explicitly.

4.2 Controlling the obsolescence risk upstream: the importance of technical choices

4.2.1 Incremental design

When the decision is taken to optimise the LCC for a product, the immediate consequence is that the technical managers have to envisage the architecture of the product and its development over the whole life cycle in order to produce and optimise cost estimates. An analysis of Moore's law helps understanding the benefit of carrying out this exercise (and, incidentally, proves how difficult it is). This law states that on average the geometry of semiconductors decreases by 15% per year. This has proved true over the last 30 years and should continue to be so for at least the next ten. The consequence of this (see figure 3) is that chip performance doubles every 15 months, or increases tenfold every 4 years, or increases by a factor of 1,000 every 12 years. Unless it is prices that, for constant performance, drop by the same proportions, or any other intermediate solution.
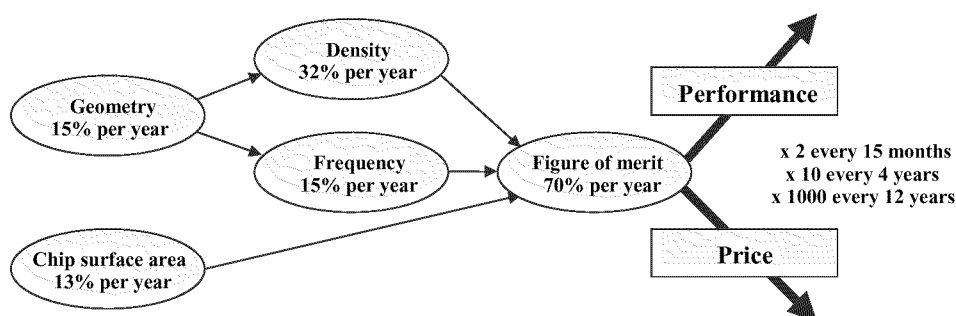
Figure 3: Moore's law and its consequences

This explains why the consumer industries are constantly bringing out new models: which child would buy a play station designed 15 months ago when a competitor has just brought out a new version that's twice as powerful? As a result, the components come onto the market and disappear one after the other at the same speed, fortunately with a lag on withdrawals due to production cycles.

The difficulty for the professional electronics industries is that the quantities sold are much lower and therefore the design and industrial development costs are proportionately a much greater factor in the production cost. Moreover, and for reasons of equipment homogeneity, the customer will want to be able to buy the same product for several years, or at least a product with an identical external interface – and yet still benefit from the price reductions due to technological developments.

In professional electronics, the manufacturer must therefore do the following simultaneously:

1) somehow resolve obsolescence problems so that it can continue production;

2) constantly improve the competitiveness of its products (price and performance) so that it can continue to sell;

3) minimise redesign/re-industrial development costs, which are very high overall.

The solution proposed within the Thomson-CSF group to reconcile these three aims is to use an incremental design procedure.

This procedure can broadly be compared with the well-known procedure in the US known as RASSP (see [6]). We will therefore limit ourselves to a general description of it.

The aim of incremental design is to define a procedure to optimise the LCC. This procedure applies to the whole life cycle. The first stage (and probably the most important and most difficult stage) consists of analysing the LCC from the start of the project in order to optimise it. This involves making projections far into the future in order to anticipate changes in architecture and draw up estimates of the cumulative recurrent and non-recurrent costs over the whole life cycle of the equipment. In most cases, this LCC optimisation process leads to breaking the equipment down into modules and a strategy of gradually improving the modules one by one over the years. It also leads to a clear definition (stabilisation) of the portability interfaces between modules, so that one module can be upgraded without affecting the operation of the other modules. (It must be noted that these can be hardware or software portability interfaces).

The idea is to take inspiration from the automotive industry. For years, manufacturers offer a product with the same name and more or less the same external interface. Every year, a new model comes out with an "extra feature" (increased performance, improved comfort, lower price, etc.) designed to make it more attractive to customers. However, the whole car has not been redesigned from scratch. Inside, everything is designed in modules, and every year one or two modules change and the rest remains identical.

This kind of process is the opposite of the process that used to be conventional in professional electronics, whereby a piece of equipment was designed to be reproduced identically for years. This often leads to specifying performance at the very limit of what was feasible at the time, and therefore to taking risks, increasing costs, causing delays, etc. This conventional approach is no longer conceivable today. After a few years, for one thing the original components have been withdrawn, there are no equivalents available and no-one knows how to produce the equipment any more. For another thing, competitors have placed a more recent and therefore higher performance, cheaper product on the market, and it is impossible to sell the old product. Moreover, the economic pressure on budgets means that the next generation cannot be redesigned from scratch.

The advantage of incremental design is that, due to anticipation and modular design, gradual upgrades to the equipment can be scheduled, which allows the manufacturer to avoid high and recurring redesign costs. From the customer's point of view, this approach allows them to benefit from the advantages of technology progresses: enhanced performance and/or reduced costs.

Figure 4 summarises this approach and outlines the rules set out within Thomson-CSF for its implementation.
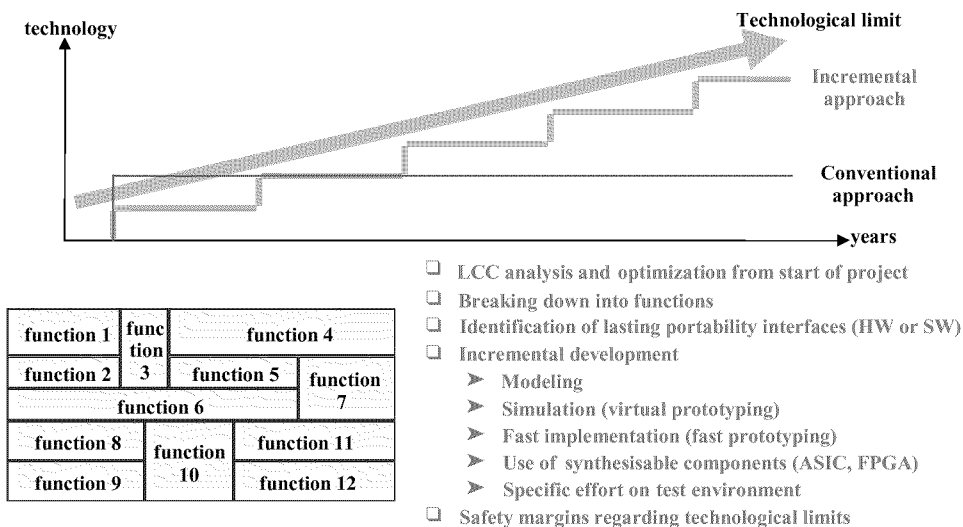

Figure 4: The incremental design approach

Of course, one can object that incremental design does not apply to all situations.

Firstly, it requires the customer's cooperation. The customer has to accept that the equipment supplied throughout the whole life cycle will be compatible (it will have the same external interface), but not necessarily 100% identical inside. It must also agree to not demand extremely high levels of performance immediately, as this often makes it impossible to break the equipment down into modules. As a matter of fact, it is much better to build in safety margins regarding technological limits and break the equipment down into modules that will allow for the product to be improved over its whole life cycle: as performance is doubled every 15 months, it is better to implement a less than optimum solution very quickly rather than introduce delay just to gain 20%.

Secondly, the incremental design approach must be modulated/adapted for large production runs when recurrent costs are much greater than non-recurrent costs.

Thirdly, it may be hardly applicable when the product will have a very short life cycle.

However, even in this last case it (or more precisely, a variant of it) may be worthwhile if it can be applied simultaneously to several products; one interesting approach used by Thomson-CSF units with several products with similarities is to design common modules for the products and implement an incremental design policy for these modules, which often have a longer life cycle than the products.

In all cases, the rule is to analyse the evolution of the architecture over the whole life cycle from the start of the project. Whether it will be beneficial to use incremental design or a variant of it will become clear from the analysis. Technoprice (cf. §3.4) is the tool used at Thomson-CSF to provide the elements required for this analysis.

4.2.2   The COCISPER methodology

The almost complete withdrawal of MSI components today and the increasing scarcity of standard VLSIs in favour of components that provide increasingly specialised functions (ASSP or even ASIC) mean that the professional electronics industry has to turn increasingly to specialised components (ASIC or, if quantities do not allow for this, FPGA).

For the professional electronics industry, items such as FPGAs are an excellent response to obsolescence problems. As he possesses the VHDL description, the manufacturer has control on the function performed by the component and is in a better position to solve obsolescence problems. Furthermore, FPGAs also provide a solution to the problem of performance upgrades mentioned in the previous paragraph.

However, they are subject to obsolescence themselves.

In the event of obsolescence, it is important that the manufacturer knows how to "carry" the function performed by the obsolete component over to a more recent component at a low cost (often with the possibility of grouping functions together). To ensure this kind of control, French manufacturers have defined a methodology for mastering ASICs and FPGAs lifecycle with the help of the DGA. A description of this can be found in another paper at this conference (see [7]).

4.2.3   The use of a components preferred parts list

We will not go over this subject again, as it was amply covered in §3.3. However, it is obvious that using components carefully selected for their long-term availability prospects and then carefully monitored for obsolescence is a major factor in minimising the obsolescence risk.

4.3   Controlling the obsolescence risk downstream: the role of organisation
4.3.1   Organisational reactivity

In the downstream phases (production and use phases), that is, once the equipment has been designed and developed, the main skill a manufacturer needs to control obsolescence is reactivity, i.e. the ability to make the right decision in due time (often very quickly) when a problem arises. It must be noted that, in some serious situations when the manufacturer will not be able to manage the problem alone, it will have to inform the customer and decide with it what steps to take. This is also part of the "right decision".

It is well known that in a company, the key to reactivity is organisation.

However, this is also where the main difficulty lies when it comes to obsolescence. Reactivity in the event of obsolescence requires the implementation of a fairly complex process within the company as:

- several activities are involved:
  - purchasing (which encounters the problem, and can also suggest solutions),
  - production (which has to be reorganised),
  - technical (which can also suggest solutions),
  - project management (which has to arbitrate),
  - sales (if there are sales consequences),
- very often several contracts, or even several products are affected, so that the optimum decision must be made by several people in the light of constraints (volumes, deadlines, customer wishes, etc.) that can vary significantly from one contract to another.

Faced with this problem, the Thomson-CSF units have implemented rather varied organisations.

For example, in a unit that had designed a strategy of modules that were reusable from one product to another, the organisation chosen was to set up a body with the task of guaranteeing the supply of modules to the products in spite of obsolescence problems. This body finances the action necessary for effective obsolescence management with a percentage of the price of the modules delivered.

In another unit with ASIC based products, the organisation chosen was to systematically analyse all current and foreseeable needs (raised by either obsolescences or upgrading policy) for every product so that every ASIC designed covers as many of these as possible.

It is nevertheless rather difficult to transpose such best practices from one unit to another, as they are very much linked to a local situation (organisation, type of product, customer, etc.).

The decision within the Thomson-CSF group was therefore to simply collect these best practices together and make them accessible to everyone, but purely for guidance.

However, it did seem useful to highlight a certain number of rules of conduct. These rules in no way impose a type of organisation. They form a list of questions to ask in order to judge whether or not a type of organisation is appropriate. They appear in a document, the "Thomson-CSF Baseline", which groups together the rules that all units should follow, activity by activity.

These are just a few of them:

- systematically analyse all of the obsolescence warnings,
- identify their impact on all of the equipment,
- immediately analyse the consequences of this,
- take into account all of the contracts and products affected,
- take advantage of the synergies between products to combine equipment upgrades and obsolescence management,
- make sure that the decisions taken are followed up in the deadlines,
- in particular, comply with the LBO dates,
- inform sales of the consequences of obsolescence on costs and deadlines.

As will be seen, these are all very obvious, if not banal, points. However, when these rules were drawn up in 1994-1995, they had their uses. Although they are easy to say, they are much more difficult to implement in a complex organisation. Readers with experience in industry will doubtless agree.

4.3.2 *Ability to anticipate problems*

Given the complexity of the process mentioned earlier (gathering of information + decision making), obsolescence warning times that might seem quite comfortable (typically 3 to 6 months) are in fact very short, so the final decision is often taken urgently.

A good way to increase reactivity is to know how to anticipate the problem.

This is why it is beneficial, as mentioned in §3.2, to review the part list for every piece of equipment regularly (every 12 months) in order to:

- analyse the predicted end of life date of each component in the equipment,
- update the sales projections for the equipment,
- depending on these two analyses, update the projected redesign dates and the course of action to be taken until the next date.

Moreover, anticipating problems through systematic part list reviews is not just a way of increasing reactivity. As pointed out in §3.2, it is also a way of finding the optimized solution, i.e. a solution that, instead of solving problems individually as they arise, incorporates them into a more general and probably more cost-effective procedure.

5. Conclusion

Controlling obsolescence problems, i.e. the ability to offer long-term availability and/or upgradeability (depending on the customer's requirements) is therefore increasingly seen as a fundamental component of professional electronics manufacturers' know-how.

It responds to increasingly high expectations from all types of customer, whether domestic or export, in aerospace, defence, telecommunications or industry.

This control means that the manufacturer must implement an organisation, principles, methods and tools that guarantee its customers:

- a systematic attitude of risk anticipation and limitation, from the most upstream phases to the most downstream phases of a programme, in order to set out the most pertinent strategy at all times,
- excellent reactivity to deal with problems quickly and effectively when they arise,
- a relationship of trust between the manufacturer and its customer, in which the manufacturer keeps the customer informed of the main actual or potential problems and advises it on its requirements, so that these requirements encourage the implementation of an effective obsolescence control strategy.

The system described in this paper, implemented by TTM and currently fully operational within Thomson-CSF, shows how common tools and methods can greatly help each of the units in the group offer every customer the most professional and cost effective process to guarantee this level of obsolescence control.

This system must itself come within the framework of organisation and processes specific to each unit, as they depend to a large extent on the specific context of each field, market and customer.

The Thomson-CSF group is willing to allow other manufacturers to use all or part of this system within the framework of a partnership agreement, and to reap its benefits.

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About the author

Gérard Gaillat is the Technical Director of Thomson-CSF Technologies and Methods (TTM).

TTM is a corporate entity with the task of setting out and implementing the methods, tools and technological choices common to all of the Business Units in the Thomson-CSF group.

In this framework, TTM is responsible for co-ordinating the Thomson-CSF group's anti-obsolescence strategy, defining the methods for this and distributing common tools.

Gérard Gaillat is also a member of the EDIG (European Defence Industry Group) Technical Committee, on which he represents the French defence electronics industry.

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